

DOCUMENT RESUME

ED 042 621

24

SE 009 323

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TITLE Development and Fvaluation of Instructional Materials for General Mathematics Curriculum for Grade 10, Final Report.
INSTITUTION Wilmington Public Schools, Del.
SPONS AGENCY Office of Education (DHEW), Washington, D.C. Bureau of Research.
BUREAU NO BR-9-B-069
PUB DATE Feb 70
GRANT OEG-2-9-170069-1038 (010)
NOTE 15p.

EDRS PRICE EDRS Price MF-\$0.25 HC-\$0.85
DESCRIPTORS *Curriculum, *Evaluation, Grade 10, Instruction, *Instructional Materials, Low Achievers, *Material Development, Mathematical Applications, Mathematics Education, *Secondary School Mathematics

ABSTRACT

This is the final report of a project developed to plan a program that can be used as a basis for the teaching of tenth grade general mathematics. A set of ten units that provide most of a year's work in tenth grade general mathematics was designed. A brief description of the topics included in each of these units is given. Also described are the procedures used for designing the ten units.
(FL)

FINAL REPORT

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

Project No. 9B069
Grant No. OEG-2-9-170069-030(010)

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DEVELOPMENT AND EVALUATION OF INSTRUCTIONAL
MATERIALS FOR GENERAL MATHEMATICS
CURRICULUM FOR GRADE 10

ED042621

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February 1970

The research reported herein was performed pursuant to a grant with the Office of Education, U.S. Department of Health, Education, and Welfare. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their professional judgment in the conduct of the project. Points of view or opinions stated do not, therefore, necessarily represent official Office of Education position or policy.

U.S. DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE

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Acknowledgments

The help of Dr. John Brown who served as consultant on this program, was a big factor in giving solid direction to the project.

The teachers who did the principal writing for the project units are Mr. Arthur Gibson, Mr. Raymond Wilson, and Mr. Leon Davis. Their keen interest in general students, and their consistent dedication to the work, made it a profitable venture.

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Summary. This project was developed to fulfill a need to plan a program that provides for the education of tenth grade students who may not be planning to enter college. Approximately 65% of the tenth grade students in Wilmington do not plan to attend college. There are many differences among these students yet we find them grouped heterogenously in many tenth grade general mathematics classes.

Accepting the hypothesis that any subject can be taught effectively in some intellectually honest form to any child in any stage of development, the objectives were to write units of work that incorporate practical applications from the events and affairs of urban life, providing in these units differentiated activities and exercises that would appeal to the interests of the variety of students that we find in tenth grade general mathematics classes.

To accomplish these objectives the director and three teachers, all of whom had extensive experience in teaching general mathematics, met for six weeks. They reviewed the recommendations of previous general mathematics curriculum committees in Wilmington; they reviewed many collected references on the subject; they met with a consultant from the college level; they visited local industrial plants and consulted with representatives from those plants; they polled student interests; and they then wrote the units as planned. The result is a set of ten units that can provide most of a year's work in tenth grade general mathematics. Units that are included are: I. D.O. Math (Diversified Occupations); II. Algebra; III. Banking; IV. Geometry; V. Taxes; VI. Graphing; VII. Data Processing; VIII. Probability; IX. Insurance; and X. Hospital Work.

To supplement the work of each unit, the teacher is provided with a number of ditto masters from which worksheets can be made as desired. Teachers' copies of the program provide many teaching suggestions.

Materials were provided for seven experimental classes and are now in use. The five teachers who are using the materials are meeting periodically during the school year to evaluate the units and to rewrite as necessary. It provides experimental material that should aid a teacher in providing instruction with built in motivating factors, such as references to current interests of students, use of examples from local industry, presentation of some informal mathematics for its own sake, and use of some learnings that are completely new to the students. Woven into the material is a wealth of practice in working with the fundamental operations with whole numbers, fractions, and percents and some informal geometry.

Introduction. How best to provide a mathematics program that meets the needs of ninth and tenth grade general mathematics students in Wilmington, Delaware has been the topic of major thinking and planning on the part of high school mathematics teachers in this city for a number of years. Many texts have been used, and each teacher has tried, first, to analyze the needs of his students as he found them, and second, to plan his teaching to fit these needs. This may well be the way of many classes throughout the nation, but our teachers have not been satisfied that their efforts were as successful as they might be with a more suitable program and better materials of instruction.

In 1964 various committees in Wilmington started to develop a program for these two grades that would meet the needs of ninth and tenth grade general mathematics students. They sought to unify the instruction and to provide spiral learning that would develop in a logical way the learning of fundamental operations with whole numbers and fractions, an understanding of per cent, and some informal geometry, as well as some understanding of the structure of mathematics and a liking for mathematics.

A kick-off meeting was held in November, 1964, when Mr. Sol Weiss, professor of mathematics at West Chester State College, Pennsylvania and a former teacher of general mathematics in Philadelphia, helped organize the planning for the improvement of the program. Objectives developed at that and subsequent meetings in the 1964-1965 school year were: 1. Meet needs in today's world. (Practical Applications from Industry and from Consumer Problems); 2. Develop Reasoning Power; 3. Teach arithmetic skills; 4. Adjust to individual needs; 5. Include some structure of mathematics; and 6. Develop enjoyment of mathematics. Also, at these meetings 77% of the faculty agreed to the hypothesis: "Any subject can be taught effectively in some intellectually honest form to any child in any stage of development." Many who agreed added provisions. Here are a few of these:

- Must recognize individual differences.
- Must have adequate materials.
- Need small groups (14-21 students).
- Need adequate time.
- Eliminate emotionally disturbed children from slow learner classes
- Teachers need preparation in methods of instruction with slow learners.

Important recommendations for program development came from meetings in each school (5 schools have ninth grade classes, 4 schools have tenth grade classes). The following Philosophy Statement was accepted in January, 1965:

A PHILOSOPHY FOR TEACHING GENERAL MATHEMATICS IN GRADES NINE THROUGH TWELVE

We believe that students need to see purpose and meaning in their learning experiences.

We believe that teachers of secondary mathematics should accept and consider the heterogeneous makeup of the secondary school population. In order to prepare their students to advance in any future direction that their interests may take them, teachers should seek to discover the needs of their students, to appeal to the interests of their students, and to provide a suitably solid mathematical foundation for their students at every level of mental ability and social development that they find in their classes.

With this general philosophy in mind we have the following objectives for the teaching of general mathematics in grades nine through twelve:

- Provide a program that leads students to understand the needs of today's world and prepare students to meet these needs.
- Provide a sequential program that helps students to develop skills in the fundamentals of mathematics.
- Provide a program that stimulates students to reason logically and to develop mathematical ideas.
- Provide a program that develops in students an appreciation of mathematical structure.
- Provide a program that is flexible enough to adjust to individual needs.
- Provide a program that encourages students to enjoy mathematical experiences.

The General Mathematics Program Committee also agreed to the following overall program statement:

The consensus was that the program should, in general, be one that provides for teaching important ideas in a spiral development. That is, a great variety of topics should be included at each level, with each higher level including more advanced stages of the development of each topic. Topics to be considered are fundamental operations with real numbers, mathematical structure, topics in algebra, informal geometry, logic, measurement, probability, statistics, business mathematics, shop mathematics, occupational mathematics, and consumer mathematics.

-- The development of topics should be related to real life problems as encountered by people near to the students' age level, wherever possible.

-- Interwoven with the study of any operations or principles should be a developmental explanation of why they operate in the way that they do.

-- Possibly a third track should be developed for students who are in need of remedial help.

By June, 1965, a tentative outline of topics was accepted and a proposal was written to get federal support to provide funds for a writing team to work on this program during the summer. Since the project was not yet approved, the committee continued to operate in the 1965-1966 school year on a part-time basis, and started meeting with representatives of local industry to get their suggestions and to solicit practical problems from them. Some excellent ideas were forthcoming from these meetings.

When the project received federal funding the final writing team was determined and we met with Dr. Vincent Haag, professor of mathematics at Franklin and Marshall College, to plan the work. Only the ninth grade part of our work was included in this project. We had funding for six weeks' work.

Our objectives were:

--To write units of work that incorporate practical applications from the events and affairs of urban life into a general mathematics outline that is modern in its scope.

--To seek out problems from local industry that relate to situations that general students will occupy within a few years after their ninth grade study.

--To write units at a reading level compatible to that of slow learning ninth grade students.

--To incorporate in the units provision for differentiated instruction that helps the teacher challenge each level of student at his own level.

--To keep a developmental treatment of concepts as the heart of the program, with many practical problems used as illustrations.

--To plan the instruction taking into consideration ways in which these students learn. The use of role playing, games, and programmed materials for makeup as well as enrichment, should be written into the program. Real problems that involve student-activity as well as laboratory work should be included.

A basic decision was made to start units with some situation and then to develop aspects of mathematical learning within the situation. We already had a basic outline of the mathematics we wanted to include. We then sought situations that could serve as motivational factors and that could couch the learnings we were seeking to develop.

With this foundation the director and three teachers wrote the ninth grade materials in 1967. They were tried by the project teachers in 1967-68, and some additions were made in the summer of 1968. Evaluative bi-monthly meetings were held to coordinate the work and incorporate new ideas developed by individual teachers. In 1969 we were ready to write the tenth grade materials, and this project was initiated. The work was done in the summer of 1969.

Method. The group of three teachers and the director met on alternate Tuesday afternoons in May, 1969 after school and full time for six weeks from June 16 to July 25, 1969. Dr. John Brown, our consultant, met with us on six mornings. We discussed the many suggestions that had already been made by groups working on the program. We reviewed literature on working with slow learners and perused many reports of other work done in general mathematics around the nation. We called in representatives of local industry and went to visit industrial locations to seek practical problems for use in the program. We interviewed general mathematics students to determine their interests.

We decided on the particular situations that we would include, the mathematics concepts that we wanted to cover, and the sequence of units. Each member of the group then concentrated on a few of the units, with frequent consultations with the whole group. The director coordinated the work by reviewing the aims of each unit with writing team member as the writing was progressing, and by suggesting varied activities for consideration.

Many of the worksheets used are also furnished in ditto master form for the teacher to use as he wishes. Suggestions for group activities are included throughout the teacher pages.

Results. The project produced a program, called the Wilmington Operational Mathematics Program, Book II, that can be used as a basis for the teaching of tenth grade General Mathematics. It consists of a set of ten units of work. The units are included in two

student volumes: Wilmington Operational Mathematics Program, Book II, Part I; and Wilmington Operational Mathematics Program, Book II, Part II. Student volumes are three-hole-punched so that they may be kept in notebooks. Both student volumes are included in one teacher edition, which contains teaching suggestions and answers to exercises (see Appendix A). The teacher is also provided with a set of ditto masters separately for each unit. The units written are: Unit I: D.O. Math (Diversified Occupations); Unit II: Algebra; Unit III: Banking; Unit IV: Geometry; Unit V: Taxes; Unit VI: Graphing; Unit VII: Data Processing; Unit VIII: Probability; Unit IX: Insurance; and Unit X: Hospital Work.

The first unit, D. O. Math, involves students in role playing with regard to job applications. Its point of reference is the Diversified Occupations program in the school. Students in the program attend school half a day and work half a day. The work of the unit leads into testing for job applications and thus to a review of arithmetic operations. Its purpose is to help the teacher identify the abilities and placement of his students.

Unit II, Algebra, provides a prestige unit that again indirectly leads into review and practice with fundamental operations. It also allows the teacher room to discuss mathematical structure as he sees fit.

Unit III, Banking, provides a topic of general interest that is related to the local business world.

Unit IV, Geometry, appeals to the students' natural interest in this subject in an informal way. An especially interesting reference is to latitude and longitude on the moon and to points identified with moon landings.

Unit V, Taxes, appeals again to the general interest of students. After reviewing property taxes, it uses the income tax as an interest getter. It is timed to come when some students will be needing the information for their own tax computation.

Unit VI, Graphing, introduces ideas on using a grid to help study relationships that can be graphed. It then provides opportunities to look at and to construct various kinds of graphs that show a numerical relationship picture.

Unit VII, Data Processing, uses the natural high interest in this new topic to lead students into developing thought processes via the study of flow charting.

Unit VIII, Probability, appeals again to various natural student interests while giving further development of mathematical principles.

Unit IX, Insurance, uses student interest in automobiles as a jumping off point to understand the need for and some uses of insurance.

Unit X, Hospital Work, introduces metric measure through reference to actual problems that arise in jobs that these students might find in a local hospital.

Five teachers are now using these materials in seven tenth grade general mathematics classes. Teachers have been instructed that they may use the materials as they see fit. They have met to evaluate the program and are generally well satisfied that many of our objectives are met. Criticisms and suggestions have been noted and we will try to get in-service time to add improvement items to the program this summer. As soon as final funding is received, a number of game-type materials that have been evaluated will be bought for use in these classes.

Cassette tape recorders have been purchased, and some experimental work has been done with them, but it is minimal. Development of the use of this medium will take place in further workshops that we plan to conduct in this and future summers.

Conclusions

With the work of this project added to that of a previous one that developed ninth grade materials, the Wilmington Operational Mathematics Program now provides a two-year sequence of materials of instruction that develop mathematical learnings for ninth and tenth grade general mathematics students.

Mathematics teachers who are using the program materials are meeting regularly to evaluate and coordinate the work. Their many suggestions for improvement and added materials that they have developed are being collected by the director of the program for use in further revisions.

There is a need, now, to provide a summer workshop for a few teachers in the program to revise and expand the materials that have been developed for the ninth and tenth grade general mathematics curriculum.

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APPENDIX A

**Teachers Edition of Wilmington Operational
Mathematics Program, Book II
(only five copies available)**